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**NATURAL RESOURCES INTERIM COMMITTEE**  
**NORTH IDAHO AQUIFER WORKING GROUP**

The North Idaho Aquifer Working Group will in consultation with stakeholders develop a framework for management of the Moscow/Pullman and Rathdrum Prairie Aquifers to Ensure the Long-Term Sustainability of the Ground Water Supply for all Beneficial Uses in Accordance with the Prior Appropriation Doctrine as Established by Idaho Law.

**INTRODUCTION**

The Legislature, through House Concurrent Resolution No. 56, directed the Natural Resources Interim Committee to “conduct a study regarding water supply and management issues in the Moscow, Rathdrum Prairie, and Snake Plain Aquifers and the Bear River Drainage.” The Natural Resources Interim Committee intends to use the North Idaho Working Group to review and formulate both short-term and long-term management goals and objectives for the Moscow/Pullman and Rathdrum Prairie Aquifers.

**THE RESPONSIBILITIES OF THE NORTH IDAHO AQUIFER WORKING GROUP**

The North Idaho Aquifer Working group will make recommendations to the Natural Resources Interim Committee on the following matters:

- 1) Recommend actions the State should undertake to assist or supplement the efforts of the Palouse Basin Aquifer Committee (PBAC).
- 2) Evaluate and make recommendations regarding an administrative structure for ensuring that short-term and long-term Moscow/Pullman Aquifer management goals and objectives are implemented;
- 3) Study and recommend methods for funding implementation of Moscow/Pullman Aquifer System management goals and objectives;

- 4) Review the draft ground water management plan for the Rathdrum Prairie and recommend actions the State should take to assist in the drafting and implementation of a final ground water management plan for the aquifer.
- 5) Evaluate and make recommendations regarding an administrative structure for ensuring that short-term and long-term Rathdrum Aquifer management goals and objectives are implemented;
- 6) Study and recommend methods for funding implementation of Rathdrum Prairie Aquifer management goals and objectives;
- 7) Recommend whether an adjudication of the water rights in the Rathdrum Prairie should be pursued; and
- 8) Recommend how Washington State and Idaho interests in the aquifers should be addressed.

#### OVERVIEW OF MOSCOW/PULLMAN HYDROLOGIC CONDITIONS AND WATER SUPPLY ISSUES

##### 1) Description of Aquifer System:

The aquifers that underlie the Moscow area are in the easternmost part of a much larger basin, most of which is located in the state of Washington. Ground water recharge occurs in both Idaho and Washington with natural ground water discharge out of the basin to the west in Washington. Long-term water level decline and interstate ground water management are major issues for the Moscow ground water system.

Moscow is underlain by two major aquifers hosted in basalt and sediments. The upper aquifer occurs in the depth range of about 250 to 500 feet in layered sand zones and basalt. Wells completed in this aquifer yield up to 1,500 gpm (gallons per minute) with a non-pumping depth to water of about 60 feet. The lower aquifer is in the depth range of about 650 to 1,400 feet in basalt. Wells completed in the lower aquifer yield up to 3,000 gpm with the non-pumping water level about 300 feet below land surface.

The water supply for both the City of Moscow and University of Idaho prior to about 1965 was supplied from the upper aquifer. Non-pumping water levels in city wells completed in the upper aquifer had declined to more than 140 feet below land surface by the mid 1960's. Deep wells were drilled for both the city and university in the 1960's and all water withdrawal was shifted to the lower aquifer at that time. Water levels in the upper aquifer recovered to about 50 feet below land surface by the 1980's. The City of Moscow pumps some water from the upper aquifer at this time. The present ground water levels in the upper aquifer are about 60 feet below land surface, approximately the same as in the 1940's.

The primary supply for both the City of Moscow and University of Idaho has been derived from the lower aquifer since the 1960's. Pumping from these wells, plus those in

Pullman and Palouse, has resulted in a water level decline at a rate of 1.0 to 1.5 feet per year for a number of years. This rate of decline has been measured in wells in Moscow, Pullman and Palouse. Water-level data from deep wells near Moscow appear to show a smaller rate of water-level decline starting in about 2000. This decrease in the rate of water-level decline, if it continues, is important relative to how ground water in the area is managed in the future.

2) Physical Characteristics:

Subsurface geology of the Moscow-Pullman area is dominated by basalt, with thick layers of sediment mostly along the eastern margin of the basin. The basalt and sediment overlies older rocks that make up Moscow Mountain and Paradise Ridge. The two geologic units of greatest importance are the Grande Ronde Formation and the Wanapum Formation, both part of the Columbia River Basalt Group. The Grande Ronde Formation hosts the lower aquifer and the Wanapum Formation hosts the upper aquifer. The total thickness of basalt and sediment is about 1,400 feet under downtown Moscow with more than 2,200 feet of mostly basalt under Pullman.

The individual basalt flows in the Moscow-Pullman area average about 150 feet in thickness. The Wanapum Formation includes one basalt flow in the Moscow area while the Grande Ronde Formation includes a number of basalt flows. Water producing zones are present along contact zones between individual basalt flows. Upper aquifer wells obtain water from the lower portion of the single Wanapum basalt flow and the underlying sand zones. Lower aquifer wells obtain water from basalt contact zones in the general range of 600 to 1,400 feet below land surface. The individual aquifers are identified primarily by depth to water (presently about 60 feet for the upper aquifer and about 300 feet for the lower aquifer) and by well depth.

Recharge to the upper aquifer occurs from infiltration of precipitation and stream loss. Recharge to the lower aquifer occurs primarily as downward leakage from the upper aquifer. Recharge to the upper aquifer is greater than to the lower aquifer although the present estimates of recharge rates have large error bands. The amount of recharge to the lower aquifer is limited primarily by the very low vertical hydraulic conductivity of the sequence of basalt flows and sedimentary layers.

3) Problems and Constraints:

The long-term water level decline in the lower aquifer is the primary concern for local water managers as well as the Idaho Department of Water Resources and the Washington Department of Ecology. The primary management question is whether there is enough recharge to the lower aquifer to sustain present and anticipated future water withdrawals.

The Moscow-Pullman area has a long history of local ground water management activities. Efforts of the Pullman-Moscow Ground Water Committee led to a combined University of Idaho/U.S. Geological Survey study in the 1980's. The resultant report by Lum and others (1990) presented the results of a computer model of the two-aquifer system. The primary predictions of the model were that: 1) ground water levels will continue to decline if pumping amounts continue to increase annually, and 2) ground water levels will stop declining (within 10 to 15 years) if pumping amounts are stabilized.

The Pullman-Moscow Ground Water Committee was expanded and renamed the Palouse Basin Aquifer Committee (PBAC) in the late 1980's and serves as an interstate planning and management body. The present goals of PBAC are: 1) ensuring a long-term quality water supply for the Palouse Basin communities, 2) stabilizing the deep or Grande Ronde aquifer system

water levels by 2020 and 3) accomplishing the above in an economically efficient manner. The entities represented on PBAC include cities (Moscow, Pullman and Colfax), counties (Latah and Whitman) and universities (University of Idaho and Washington State University). Only the cities and the two universities pump water from the deep aquifer system.

PBAC set out in 1990 to stabilize pumping from the deep aquifer and thus water levels based on the recommendations in the 1990 UI/USGS report. For the past 14 years the deep aquifer pumping entities have essentially held pumping from the deep aquifer stable through conservation measures, shifting irrigation to waste water treatment plant effluent (at UI) and shifting some pumping to the shallow aquifer system (at Moscow).

Water-level data from a test well midway between Moscow and Pullman indicate an average decline of 0.7 feet per year since 2000. This decrease in the annual rate of water-level decline may be a result of stabilizing pumping from the deep aquifer but more monitoring is needed to speak definitively.

4) Uncertainties:

Geologic knowledge of the subsurface in the Moscow area and portions of the basin in Washington has increased greatly in the last ten years because of PBAC supported research, but a number of additional questions need to be addressed. Chief among these is whether the deep aquifer represents a single ground water system throughout the basin or whether effective sub-basins are present. Construction of new wells in areas where information is missing is critical to this effort.

Collection of water level data in wells not used for production is critical for basin analysis. To this end, observation wells need to be drilled into the deep aquifer at several locations within Idaho.

Enhancement of recharge to the deep aquifer in the Moscow area has been proposed in the past. One of these proposals involved injection of treated surface water or treated wastewater into the upper aquifer. Assuming all water quality and water quantity questions are answered, this water could either be pumped out of the shallow aquifer for use or transferred to the deep aquifer via controlled connector wells. Other proposals were related to increasing recharge along the base of Moscow Mountain and inducing additional recharge from the Palouse River near Palouse, Washington. Many physical, chemical, biological and regulatory questions need to be addressed relative to recharge enhancement.

5) Existing/Future Activities & Resources:

A petition was filed in November 2003 with Idaho Department of Water Resources to declare the lower aquifer in the Idaho portion of the basin as a critical ground water area and the upper aquifer as a ground water management area. IDWR has solicited public comment on the petition. This petition is under review.

PBAC is an essential component to the coordination of ground water management activities within the entire basin. The aquifer is continuous across the state line, which necessitates that water management activities include local and state representatives from both Idaho and Washington. PBAC includes representatives of all the major water users within the basin and

has demonstrated a willingness to plan and carryout water investigation and management programs. This section provides a short history of PBAC activities.

Research in the 1990's showed that actual recharge probably is less than the value used in the model and the basin is much more complex than initially envisioned. PBAC recognized the need for a greater understanding of the aquifer and members in 1999 increased their combined funding for research from a total of less than \$30,000 annually to over \$100,000 annually. As a result, water level monitoring has been greatly expanded and our understanding of the basin geology and hydrogeology has been greatly improved. Unfortunately, information is minimal or missing in some areas. Planned PBAC supported research in the next few years, including construction of test well(s), should greatly improve understanding of the aquifer system.

PBAC plans to collect critical information by 2010 so that decisions can be made on projects for increasing recharge, if needed, in order to meet the goal of stabilizing the deep aquifer water levels by 2020. The progress made, however, is closely related to funding. Two years ago PBAC thought it would receive significant funding via an appropriation from the Idaho Legislature and a grant from the Idaho Department of Environmental Quality. However, both sources of funding were lost because of the downturn in the economy.

PBAC has been notified that it will receive \$100,000 in federal funding in 2004 with the possibility of additional annual increments of \$100,000 over the next two years. This infusion of funding will allow initiation of two pilot projects that should provide important insight into options for increasing recharge to the deep aquifer system.

The Washington legislature has authorized funding for the first phase of a \$12 million effluent irrigation system for Pullman and WSU. This project, when completed, would reduce by at least 100 million gallon per year the Pullman area withdrawal from the deep aquifer.

University of Idaho plans on expanding its effluent irrigation system in the summer of 2004, which will also help to reduce further the stress on the deep aquifer. The City of Moscow has hired a conservation consultant whose report will be completed in 2004. It is anticipated that Moscow will take additional steps to reduce its pumping from the deep aquifer system based on this report.

#### OVERVIEW OF RATHDRUM PRAIRIE HYDROLOGIC CONDITIONS AND WATER SUPPLY ISSUES:

##### 1) Description of Aquifer System /Connected Water Supply:

The Rathdrum Prairie – Spokane Valley aquifer underlies a broad valley that extends from northern Idaho into eastern Washington. Recharge occurs in both Idaho and Washington with all aquifer discharge to surface water systems within Washington. Interstate ground water management is a major issue for the Rathdrum Prairie aquifer.

The aquifer is composed of glacial outwash and flood sediments deposited in a valley eroded into basalt and metamorphic rocks. Isolated remnants of basalt are present in several areas,

particularly north of Coeur d'Alene, at Post Falls and in downtown Spokane. Metamorphic rocks surround the aquifer on all but the west end.

Natural recharge to the aquifer occurs via three primary mechanisms. First, recharge occurs from precipitation and direct infiltration on the glacial sediments. Second, recharge to the aquifer occurs as underflow from the surrounding tributary valleys and as leakage from the lakes that are present in many of these valleys. Third, aquifer recharge occurs as leakage from the Spokane River in the reach from Coeur d'Alene Lake to approximately Barker Road in Eastern Washington. The river is perched above the aquifer throughout this entire reach. There are several smaller losing reaches of the Spokane River further west in Washington.

Natural discharge from the aquifer occurs to the Spokane and Little Spokane Rivers with limited additional discharge as evapotranspiration and ground water flow out of the basin. All of the natural discharge from the aquifer occurs within Washington.

Human development has done relatively little to change the natural hydrologic system in the area. Surface water was diverted for irrigation in the Spokane valley in the 1900's but has largely been eliminated in recent decades by urban development. Ground water based irrigation occurs in both Washington and Idaho but is gradually decreasing with time because of urban pressure. Essentially all of the municipal and private water supply is drawn from ground water in both Idaho and Washington. Treated wastewater from the urban areas mostly is discharged to the Spokane River. Wastewater from most of the rural areas is discharged to the ground via septic systems.

## 2) Physical Characteristics

Adema (1999) presents an excellent description of the geologic setting of the aquifer in his University of Idaho thesis entitled "Bedrock Depth and Morphology of the Rathdrum Prairie, Idaho". He describes the aquifer as follows.

The most widely accepted geologic model of the Rathdrum Prairie includes the ancestral Rathdrum River valley being filled with unknown amounts of Miocene basalt and Latah sediments, overlain by Missoula Flood Deposits. The Missoula Floods eroded much of the basalt and Latah sediments, as well as obscuring their exposure with an extensive suite of flood deposits. The flood deposits are principally composed of fine to coarse gravels of glaciofluvial origin derived from glacial outwash of the Purcell Trench Lobe and reworked by flood events.

Coarser gravels are located centrally in the valley, whereas finer sands and gravels were deposited near the margins. Some of the sands and gravels are classified as eddy and pendant bar deposits (Breckenridge and Othberg, (1998a and 1998b). The high-energy depositional environment resulted in cross-bedded gravel deposits with intercalated layers of finer sands and clays. . . .The gravel structure is further complicated by the occasional occurrence of clast cementation, identified by field investigations reported by Breckenridge and others (1997)(page 12).

The stratigraphic characteristics of the aquifer are not well understood. Recent drilling has delineated the presence of fine-grained sequences in the otherwise very coarse sand and

gravel aquifer. The finer grained sediments may reflect the presence of the older Latah sediments or simply a lower-energy depositional environment of the flood deposits.

The aquifer is unconfined with a water table slope generally from northeast to west-southwest. No significant confining layers have been identified. Water level data are available for several observation wells from the 1930's to the present. Annual and decade-long water level changes may be seen but there is no indication of major depletion of the resource.

Published reports present a variety of estimates of aquifer transmissivity. These values are derived from two different sources. First, a limited number of aquifer tests have been conducted using wells completed in the aquifer. Second, transmissivity values have been estimated from computer models constructed to represent the aquifer. Problems exist from the results of both of these approaches. Only a very limited number of aquifer tests have been conducted. Analysis of the data from these tests is constrained by the fact that none of the wells fully penetrate the aquifer and that drawdown is small even at high pumping rates. Thus, the transmissivity values estimated from the tests probably are an underestimate of the actual field values. The transmissivity values generated by the computer models represent the results of a non-unique analysis. A steady-state model can be used to estimate transmissivity within the aquifer if the recharge and consumptive pump withdrawals from the aquifer are well known. Otherwise, the transmissivity values generated by the models are directly dependent on the recharge and consumptive pumpage values assumed for the run.

Numerous attempts have been made to estimate the ground water flow across the state line using the Darcy Equation either by hand or using computer models. The inputs to the Darcy Equation are hydraulic gradient, transmissivity (hydraulic conductivity times saturated aquifer thickness) and aquifer width. This effort has a large associated error because of two problems. First, information on aquifer hydraulic conductivity along the state line is limited. Second, accurate information on the aquifer thickness is missing because most existing wells only penetrate a short distance into the aquifer. The present estimates of ground water flow across the state line can be in error by a factor of 10.

3) Problems and Constraints:

Water resource management in the Spokane Valley – Rathdrum Prairie aquifer is complex because of several major factors.

a) About two-thirds of the aquifer occurs in Idaho while the remaining one-third is in Washington. There is no inter-state compact or agreement relative to administration of this water resource system. While both states manage water based on the Appropriation Doctrine, there are significant differences in management style as well as management laws and rules.

b) Conjunctive management of surface water and ground water is not an issue in Idaho while it is the dominant issue within Washington. All surface water systems overlying the aquifer are perched within Idaho making them recharge sources that are independent of ground water levels. Ground water discharge is the primary supply source for the Spokane and Little Spokane Rivers in Washington during the low flow portion of the year. Minimum streamflow conditions are the primary driver for water management within the State of Washington.

4) Uncertainties:

The general mechanisms that control recharge to and discharge from the aquifer are reasonably well understood but the amounts need to be more accurately quantified. The three mechanisms for recharge to the aquifer are as follows: 1) precipitation and direct infiltration on the glacial sediments; 2) underflow from the surrounding tributary valleys and leakage from the lakes that are present in many of these valleys; and 3) leakage from the Spokane River in the reach from Coeur d'Alene Lake to about Barker Road in Washington. There are several smaller losing reaches of the Spokane River further west in Washington. Ground water discharge from the aquifer occurs as flow gain in the Spokane and Little Spokane Rivers and from consumptive withdrawal from wells completed in the aquifer. A small portion of aquifer discharge occurs as evaporation and transpiration from riparian areas along the rivers in Washington.

Our present knowledge of the hydraulic characteristics of the aquifer and hydraulic connection of the aquifer to different reaches of the Spokane and Little Spokane Rivers also is limited. Additional characterization of aquifer transmissivity and storativity is needed for construction and operation of a numerical model. The gaining and losing reaches of the rivers have been identified but additional information is needed on the hydraulic controls in these areas.

Conjunctive management of ground water and surface water within the two-state area requires a better understanding of the present and anticipated future water use. Water use information is needed in Idaho to compliment the information collected to date within Washington.

The potential for recharge enhancement also needs to be addressed. Long-term management of water resources within the two-state aquifer system would benefit from increased recharge. The primary focus of recharge enhancement is on the Spokane Arm of Coeur d'Alene Lake and on the Spokane River within Idaho.

#### 5. Existing/Future Activities & Resources:

On December 11, 2002, the Director of the Idaho Department of Water Resources designated the Rathdrum Prairie Ground Water Management Area. The area was established to protect the ground water resources and users of the Rathdrum Prairie-Spokane Valley Aquifer within the state of Idaho. A key component of the Director's Order is the development of a Ground Water Management Plan that balances the goals of protecting existing water users and maximizing the public benefit of the ground water resource. The plan strives to create the tools to administer ground water resources now and in the future. The plan attempts to balance protection of existing uses and the quality of the ground water resource while allowing for future development and encouraging water conservation. A review draft of that plan has been prepared.

The U.S. Geological Survey, the Idaho Department of Water Resources and the Washington Department of Ecology have initiated a study of the aquifer under the general guidance of a management committee composed of representatives from the three entities. This study will provide information needed for future decisions on water resource management in the aquifer and associated surface water systems. A work plan for federal FY 2004 is in the process of being approved and some work items have been initiated. The states of Washington and Idaho are providing support for the study in terms of in-kind services.

#### BIBLIOGRAPHY OF RELEVANT PUBLICATIONS

1) Moscow/Pullman Aquifer: PBAC acts as a clearinghouse for historic publications and ongoing research efforts within the basin. Access to the PBAC information, particularly annual reports, is available either through the University of Idaho web site or via the executive secretary's office in Moscow.

2) Rathdrum Prairie: A number of documents contain information relative to both the Idaho and Washington portions of the aquifer. A document entitled "The Spokane Valley – Rathdrum Prairie Aquifer Atlas" presents an excellent lay summary of this information. A CD listing a wide range of references is available from the Coeur d'Alene office of the Idaho Department of Environmental Quality or the Water Quality Management Program of Spokane County Public Works –Utilities in Spokane, Washington.